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ELEVEN-YEAR RESULTS OF STRIP-THINNING BY BULLDOZER IN THIRTY-YEAR-OLD LODGEPOLE PINE

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by

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ABSTRACT

Bulldozer free thinning was tested as an inexpensive means of thinning noncommercial trees in young, dense lodgepole pine stands. Bulldozered strips were alternated with 2-, 6-, and 12-foot reserve strips in addition to a 25-foot control area in a 30-year-old lodgepole pine stand in western Montana. Diameter increment of trees on the 2-foot strips was double that of trees on the control area, but volume increment was only 20 percent of that of control areas. A decrease of height growth previously reported as due to thinning was not significant after 11 years.

INTRODUCTION

One of the most frustrating problems facing foresters interested in managing young lodgepole pine (Pinus contorta) in the Northern Rocky Mountain area is how to thin vast acreages of reproduction economically. Regrowth after harvest cuttings during the past 10 to 15 years has created a large thinning job. There is not much doubt of the need to thin, for commercial yields during the next rotation could be greatly increased with management. Wikstrom and Wellner[2] have estimated that present stands of lodgepole pine on medium sites have only 26 percent of the board-foot volume that might reasonably be expected if level of stocking were controlled. The question is how to achieve precommercial thinnings economically in these stands, where few trees express dominance.

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In 1953, a study area in Montana was strip-thinned by bulldozer, and the results of examination 5 years later were reported by Tackle and Shearer.[3] This paper reports diameter and height growth 11 years after thinning.

METHODS

An abbreviated description of the study area and method of treatment is included here as a convenience to the reader.

At time of thinning (1953), the stand was 30-year-old, even-aged lodgepole pine located on a 40-percent slope on the Lolo National Forest in western Montana. Inventory before thinning showed 5,800 trees per acre, 79 percent of milacres stocked, average d.b.h. 1.5 inches, and stand composition 96 percent lodgepole pine and 4 percent larch. Total cubic-foot volume in 1953 was 1,541 ± 208 (95-percent level of probability).

A Caterpillar D-6 crawler tractor with a 12-foot blade was used for the thinning. Reserve strips 2, 6, and 12 feet wide were alternated with the 12-foot dozer swath which ran up and down the slope. Treatments removed 86, 67, and 50 percent of the volume for the 2-, 6-, and 12-foot-wide reserve strips, respectively, if we consider the dozer swath plus the reserve strip as the base area. Each reserve strip was replicated three times within the 8.8-acre experimental area; the replications of the series of reserve strips were separated by 25-foot-wide unthinned strips (two control strips in all).

Sample milacre plots were established along lines 1 chain apart crossing the slope and at right angles to the dozered strips. Control plots were located in the middle of the 25-foot unthinned area. All trees within the plots were tagged, and the following data were collected for each tree: species, crown class, d.b.h., total height, distance from edge of reserve strip. Trees were measured in 1958 and 1964, that is, 5 and 11 years after thinning.

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[2] Wikstrom, J. H., and C. A. Wellner. The opportunity to thin and prune in the Northern Rocky Mountain and Intermountain regions. U.S. Forest Serv., Intermountain Forest & Range Exp. Sta. Res. Pap. 61, 14 pp., illus. 1961.

[3] Tackle, David, and R. C. Shearer. Strip-thinning by bulldozer in a young lodgepole pine stand. Mont. Acad. Sci. Proc. 19: 142-148. 1959.

RESULTS

Trends in diameter growth that existed at the 5-year examination continued through the 11-year examination (table 1). Trees on the 2-foot-wide reserve strips showed greater responses to thinning than those on the wider strips. Significant 5-year differences in height growth disappeared, except that combined height growth for dominant and codominant trees was greater than combined height growth for intermediate and suppressed trees.

Diameter.--The combined diameter growth of dominant and codominant trees on the 2-foot reserve strips during the first 5 years after thinning was approximately 1.5 times that of trees on the control area. The combined response for intermediate and suppressed trees on these strips was five times that of trees on the control area (table 1). This response has been maintained through the second measurement period. Diameter increment of trees on the 2-foot strips during the 11-year period was about twice that of trees on the control plots.

Eleven-year diameter growth of trees on the 2-foot reserve strips was significantly greater than that of trees on wider strips insofar as intermediate and suppressed trees were concerned, but results for dominants and codominants were not as clear cut. Dominant and codominant trees on 2-foot strips did no better than those on the 12-foot strips, but trees on both these strips were significantly different from trees on the control area. Significant differences in diameter growth between trees on control plots and trees on all other reserve strips, which might have been expected from early trends, did not appear after 11 years.

Table 1.--Average diameter and height growth of lodgepole pine 5 and 11 years after thinning, by reserve strip width

Strip	Diameter growth				Height growth			
	Dominants and codominants		Intermediates and suppressed		Dominants and codominants		Intermediates and suppressed	
	5 yr.	11 yr.	5 yr.	11 yr.	5 yr.	11 yr.	5 yr.	11 yr.
Reserve:	Inches				Feet			
2 ft.	0.50*	1.19*	0.21*	0.39*	1.9*	6.4	1.2	2.7
6 ft.	0.36	0.60	0.13	0.08	1.8*	8.0	1.1	2.4
12 ft.	0.34	0.94*	0.14	0.31	3.2	7.0	1.4	3.0
Control	0.33	0.64	0.04	0.20	4.1	6.7	0.9	3.1

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* Means significantly different from control (5-percent level of probability).

Height.--Height growth of combined dominant and codominant trees was significantly greater than that of combined intermediate and suppressed trees within a thinning treatment. However, within crown classes, differences between trees on control plots and trees on other strips were not significant. The decrease of height growth inversely related to strip width after 5 years, as reported by Tackle and Shearer, was not significant after 11 years.

Distance from strip edge.--The data were also analyzed by determining relations of growth to distance from the edge of the undozed strip (table 2). After 11 years diameter growth still decreased with distance from the timber edge, continuing the trends of the 5-year examination. However, only trees on the 2-foot reserve strip showed significantly greater growth than trees on the control plot. Height growth on thinned areas was not significantly different from that on the control area after 11 years, except for dominant and codominant trees on the 2-foot strips; time is canceling out effects of thinning on height growth.

Volume growth.--Annual net growth (cubic feet) of trees on the 2- and 6-foot reserve strips was significantly greater than that of trees on the control areas (table 3). However, when the areas that were dozer bladed are included in the calculation, growth per acre on the 2-foot reserve strips (the only treatment that significantly increased diameter growth) is only about 20 percent of that on the control areas (table 3). Dozered areas were still nonstocked in 1964.

Table 2.--Average diameter and height growth of lodgepole pine 5 and 11 years after thinning, by distance from edge of reserve strip

Strip	Diameter growth				Height growth			
	Dominants and codominants		Intermediates and suppressed		Dominants and codominants		Intermediates and suppressed	
	5 yr.	11 yr.	5 yr.	11 yr.	5 yr.	11 yr.	5 yr.	11 yr.
Reserve:	Inches				Feet			
0-2 ft.	0.41*	0.91*	0.16*	0.32*	2.4*	6.4*	1.1	2.8
2-4 ft.	0.37	0.72	0.10	0.20	3.5	7.5	1.3	3.3
4-6 ft.	0.22	0.58	0.11	0.18	3.8	6.8	1.4	3.3
Control	0.28	0.60	0.05	0.08	4.2	8.0	1.0	2.4

* Means significantly different from control (5-percent level of probability).

Table 3.--Annual volume growth per acre by reserve strip width

Strip	Volume growth	
	Reserve strip area[1]	Total area[2]
Reserve:	-------- Cubic feet per acre ---------	
2 ft.	207 ± 38	30
6 ft.	262 ± 48	87
12 ft.	161 ± 27	80
Control	144 ± 17	144

[1] Plus or minus values are one standard error of the means and represent limits within which the means fall at the 67-percent level of confidence.

[2] Reserve strips plus dozered strips.

DISCUSSION AND CONCLUSIONS

The greater diameter growth of combined intermediate and suppressed trees compared to that of combined dominant and codominant trees indicates the greater initial suppression of the intermediate and suppressed trees and the greater differential between their actual and potential growth. Strong response of these trees is fairly common when thinning has released all crown classes.

The responses obtained in this study are similar to responses for diameter increment reported in other studies on thinning lodgepole pine. A brief comparison follows:

Authority	Response	Location
Roeser, 1949[4]	$1\frac{1}{2}$ to 3X	Colorado
Mowat, 1949[5]	$1\frac{1}{2}$ to $2\frac{1}{2}$X	Oregon, Washington
Alexander, 1956[6]	$1\frac{1}{2}$ to 2X	Colorado
Barrett, 1961[7]	$1\frac{1}{2}$ to 2X	Oregon
Present study	2X	Montana

The height growth data show that although trees were no doubt disturbed by thinning, they apparently are recovering, and real differences due to thinning have all but disappeared.

Generally speaking, the objectives in thinning are to sustain the growth of trees and to increase the total yield of useful material from the stand. This is accomplished by growing fewer trees to larger diameters than those usually found in unthinned stands. The only treatment that significantly increased both diameter growth and volume growth on the reserve strips was the 2-foot-wide strips. To accomplish this, 86 percent of the area was left unstocked (even after 11 years, dozered strips were unstocked), resulting in an overall volume increment of only 20 percent of the increment on unthinned areas. Considerable growing stock was sacrificed for the benefits gained.

It is possible that bulldozer thinning may be useful to lessen the overall thinning job when used in combination with conventional methods of thinning, such as hand thinning of reserve strips. However, it is not recommended as a tool for thinning young, overdense stands of lodgepole pine without additional effort to achieve desirable spacings.

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[4] Roeser, J., Jr. Results of thinning lodgepole pine. Timberman 50(6): 112, 114. 1949.

[5] Mowat, E. L. Preliminary guides for the management of lodgepole pine in Washington and Oregon. U.S. Forest Serv., Pacific Northwest Forest & Range Exp. Sta. Res. Note 54, 10 pp. 1949.

[6] Alexander, R. R. Two methods of thinning young lodgepole pine in the central Rocky Mountains. J. Forest. 54: 99-102. 1956.

[7] Barrett, J. W. Response of 55-year-old lodgepole pine to thinning. U.S. Forest Serv., Pacific Northwest Forest & Range Exp. Sta. Res. Note 206, 8 pp. 1961.

AFPS Ogden, Utah

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